Information Leaflet 106

MINUTES OF THE FIRST ALASKAN SHELLFISH CONFERENCE

JUNEAU, ALASKA
MAY 23-26, 1967

Compiled by:

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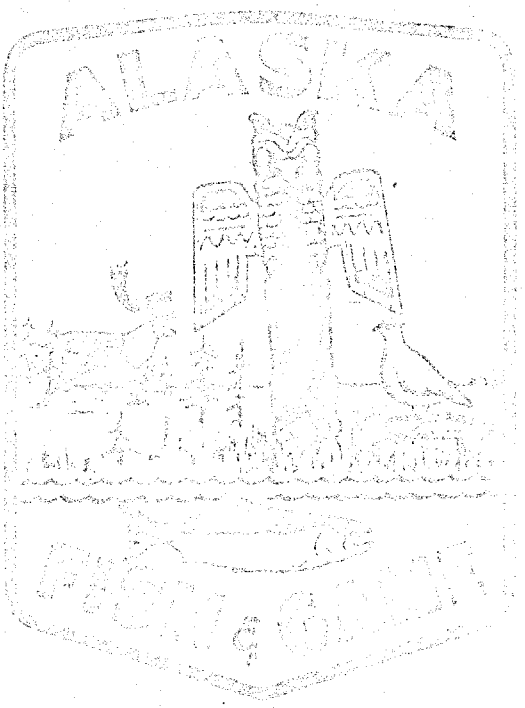
July 3, 1967



STATE OF ALASKA
WALTER J. HICKEL - GOVERNOR

DEPARTMENT OF
FISH AND GAME
WALTER KIRKNESS - COMMISSIONER
SUBPORT BUILDING, JUNEAU

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IN MEMORIAM

James Gross, malacologist with the University of Alaska, died on May 19, 1967 at the age of 55. He was born on May 8, 1912 in York, Pennsylvania. After completing his advanced education at the University of Pennsylvania he was employed by the U.S. Department of Agriculture as an entomologist. In 1949 he immigrated to Alaska and during the next 16 years worked in construction, homesteaded near Homer, Alaska, and continued to study entomology and malacology. He joined the staff of University of Alaska's Douglas Marine Station in 1965 as a senior research scientist. Jim was very enthusiastic about his work as a malacologist and was convinced that, aided by proper research, a clam fishery in Alaska could become a thriving industry. He was working toward this goal at the time of his death.

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INTRODUCTION

The First Alaskan Shellfish Conference was held in the Federal Building, Juneau, Alaska, on May 23-26, 1967. Its purpose was to provide an exchange of information and a forum for discussion between shellfish biologists of the U.S. Bureau of Commercial Fisheries (BCF) and the Alaska Department of Fish and Game (ADF&G) of the existing and latent shellfish fisheries in Alaskan waters. Dr. James Kirkwood, Chief of the Shellfish Program, U.S. Bureau of Commercial Fisheries Biological Laboratory at Auke Bay and Mr. Wallace Noerenberg, Assistant Director, Division of Commercial Fisheries of the Alaska Department of Fish and Game acted as co-chairmen during the conference. The conference was dedicated to the memory of Mr. James Gross of the Douglas Marine Laboratory of the University of Alaska, who died of a stroke on Friday, May 19, 1967.

GENERAL SESSION, INTERNATIONAL AND INTERAGENCY REVIEWS

Role of the BCF Laboratory at Auke Bay in shellfish research-- Dr. George Y. Harry, Jr.

In the past few years the shellfisheries of Alaska have continued to expand at a rapid rate. The increase in the king crab fishery has been spectacular and the shrimp and Dungeness fisheries are growing rapidly. Other

shellfish species of potential importance are clams, tanner crabs, scallops, and oysters. The shellfisheries for shrimp and king crab have increased so rapidly that the research effort leading to estimates of optimum harvest lags far behind. The State and Federal governments must work cooperatively with all available funds to lay a basis of knowledge leading to proper management of the shellfish resources.

A special responsibility of the Federal government is research related to international fisheries agreements. The Bering Sea king crab agreements with Japan and Russia call for coordinated and expanded research effort and it is the responsibility of the Federal government to see that this research is accomplished. The recent resumption of research on king crab in the Bering Sea by the Auke Bay Biological Laboratory (ABBL) is the result of agreements with the Russians and the Japanese. The research effort on king crab by the ABBL in the Gulf of Alaska was started when it appeared that there might be a significant foreign king crab fishery in the international waters of the Gulf.

A particular responsibility of the ADF&G is the collection of adequate catch and effort data on the various shellfisheries. These data are essential for proper management of the fisheries and for presenting conservation views at international meetings.

In general, the BCF is attempting to carry out the more long-term research projects needed to understand our shellfish resources with the State attempting to carry out immediate research needed for day-to-day management of the fisheries.

Role of the ADF&G in shellfish research--Mr. Wallace Noerenberg

Alaska's shellfisheries are expanding at a rapid rate; landings in the near future will undoubtedly exceed that of the salmon fishery (200-400 million pounds per annum). Shrimp landings will account for most of the expansion whereas the rest of the expansion probably will come from the tanner crab, scallop, clam, and abalone fisheries. King crab and Dungeness crab landings will probably expand moderately.

Four areas of research will be necessary: 1) Exploration and inventory of available resources; 2) experimentation and systematic attempts to introduce certain species; 3) life history of important species, leading to management technique development; and 4) applied research to assist industry in rational, efficient exploitation.

A broader base to research activities of all agencies is needed. BCF Exploratory Fishing section in particular needs expansion; similar developmental work should become a part of the ADF&G program of research. More life history work on unexploited species is needed at the University level; governmental research agencies are committed to priority programs on species now heavily

fished, primarily king crab. Large federal and state expenditures in the past on king crab are now beginning to yield useful results; diversion of some funds from king crab to shrimp research may be possible in the near future.

Vessel loan program of the BCF--Mr. James Nickerson

BCF has three programs to provide financial assistance to the fishing industry. One program provides loans at 6 percent simple interest, the second insures mortgages and loans at a premium of one percent or less, and the third offers differential construction subsidies to aid in financing the cost of new vessel construction.

The fishery loans program for vessels and gear is the most popular type of financial assistance offered by the BCF in Alaska. Loans may be obtained for financing and refinancing the cost of purchasing, constructing, equipping, maintaining, repairing, or operating new or used commercial fishing vessels and gear. Such a loan cannot be made unless the Secretary of Interior finds that the proposed vessel will not cause economic hardship or injury to efficient vessel operators already operating in that fishery.

The number and dollar values of fishery loan applications have increased during the current fiscal year to a point where available funds will be insufficient to provide for all eligible applicants. Under such circumstances, it is in the best interest of the existing fleet to reserve the limited available funds for necessary maintenance. As a consequence, no loans have been accepted or will be accepted for construction or purchase of new or used fishing vessels until July 1, 1967. It is hoped that this situation will be alleviated beginning the 1968 fiscal year.

Present and future prospects for Federal aid in shellfish research in Alaska--Mr. Fred Thorsteinson

One-third of the State's $243,000 in PL 88-309 research funds is presently spent on shellfish research, whereas the remainder is spent on salmon research. Salmon research presently funded by PL 88-309 will be funded in the near future by Anadromous Fish Act funds, thus making more monies available for shellfish research.

Research projects proposed by ADF&G should be written clearly and succintly and should result in the solution of some problem faced by resource managers or industry. BCF advisors have the responsibility to review the project proposals and the progress reports, and to give constructive criticism of the work.

Shellfish aspects of the INPFC annual meeting held in 1966--Dr. James Kirkwood

During this meeting the Japanese delegation submitted documents about: 1) the status of the king crab stocks in the eastern Bering Sea; 2) the king crab catch data collected aboard their research vessel in the eastern Bering Sea in 1965 and 1966; and 3) statistics of the Japanese king crab fishery in the eastern Bering Sea from 1961 through 1966. The United States delegation submitted documents about: 1) growth of the immature king crab; 2) movement and recovery of tagged king crabs in the eastern Bering Sea, 1955 through 1963; 3) investigations by the United States for the INPFC 1966 meeting; and 4) variations in biomass of eastern Bering Sea king crabs, based on tagging estimates of growth and mortality.

The Japanese concluded from their studies that: 1) the male king crabs were getting smaller but catch per unit effort was increasing, and 2) the abundance of king crabs was greater in 1966 than in 1965. They admitted that their data were incomplete and that their research should be intensified, but concluded that the stock was in good condition. The United States delegation disagreed with the Japanese conclusion because U.S. research in 1966 indicated that the abundance of harvestable size crab was less than during previous years when U.S. research was conducted in the Bering Sea. The U.S. also interpreted the Japanese data differently and insisted that the continuing decrease in size trend of the Japanese catch was a strong indication of over fishing. In turn, the Japanese delegation severely criticized the report on "Variations in Biomass of Eastern Bering Sea King Crabs Based on Tagging Estimates of Growth and Mortality" (Doc. 909), presented by the United States.

A joint report (appendix 4, Document 924) was prepared during the annual meeting which stated that the decline in average size of the commercial king crab catch has not been retarded by conservation measures presently in use. Also, the document summarized the data presented by both countries, and presented plans for future research.

Review of the king crab meetings of Soviet and U.S. scientists--Dr. George Y. Harry, Jr.

The Convention on the Continental Shelf stated that creatures which were in constant contact with the bottom of the sea came under the jurisdiction of the bordering country. The U.S. interpreted this provision of the convention to apply to king crab and the U.S.S.R. also agrees to the provision and is a signatory of the Convention. Japan, however, has not signed the Convention on the Continental Shelf. Although Japan is not a signatory to the convention, it has entered into cooperative agreements with the U.S. regarding the king crab fishery in the Bering Sea, and the Gulf of Alaska.

The agreements on king crab with Japan and Russia call for cooperative scientific investigations leading to a determination of maximum sustainable

yield in the Bering Sea. Under the terms of the agreements no fishing for king crab is done by either Japan or Russia in the Gulf of Alaska.

We are very fortunate in having the results of king crab studies carried out by the biological laboratory at Seattle during the period 1953 through 1961 as a basis for present studies. The earlier studies gave information on growth, migration, and population size during the period of the study. Since 1961, however, there has been a great increase in the foreign fisheries in the Bering Sea and this may have a considerable affect on the stocks of king crab.

The first meeting of U.S. and Soviet scientists took place in Washington, D.C., in March 1965. Messrs. Harry, Kirkwood, and Cleaver represented the United States and Messrs. Vinogradov and Lebedev represented the U.S.S.R. At this meeting there was an exchange of published information on king crab research. The United States reviewed past and current biological research in the Bering Sea and the Gulf of Alaska and the Soviet representatives did the same for Kamchatka and the Bering Sea. Fishing gear employed by both countries in the Bering Sea was described and fishing regulations discussed. It was agreed that there should be an exchange of previous catch and biological statistics from the eastern Bering Sea and the Gulf of Alaska by November 30, 1965. Subsequently, this information was exchanged. It was also agreed that there would be an exchange of king crab tags by November 30, 1965. Both countries agreed that there would be an exchange of scientists aboard research vessels in the Bering Sea and that both countries would observe the commercial fishing operations of the other. The scientists discussed the biological programs to be carried out in 1965 and agreed to hold another meeting in approximately one year.

The exchange of scientists between the vessels and installations of the two nations took place successfully in 1965.

The next meeting of scientists was held in June, 1966, in Moscow. The agenda for this meeting was similar to that of the Washington session with further exchanges of published material, discussions of exchange of statistical and biostatistical data, of joint Soviet and American king crab research in 1965, programs of each country in 1965, and plans for 1966. The Soviets by a great effort made copies for the U.S. of all Soviet literature on king crab dating back to the early 1800's. The U.S. scientists stressed the need for good biostatistics from the Soviet motherships. The Soviets stressed the need for a more orderly fishing arrangement with the Japanese in the Bering Sea. The U.S. did not care to get into this latter question at a scientific meeting and stressed that it was primarily a matter of gear conflict. Russia also emphasized the need for obtaining Japanese king crab statistics from the Bering Sea and subsequently these have been supplied.

It was agreed that there would be a meeting in the U.S. prior to

April 1, 1967, should the agreement on the Soviet fishing on king crab in the Bering Sea be extended after February, 1967.

King crab negotiations in 1966-1967 with Japan and the Soviets--Dr. James Kirkwood

The king crab agreement between the United States and Japanese government was re-negotiated in November, 1966. During these negotiations, Dr. Kirkwood presented a report on the condition of the eastern Bering Sea king crab stock to the American section and later during an open plenary session.

The king crab agreement between the United States and Soviet governments was re-negotiated in February, 1967. A report similar to that presented at the Japanese meeting was presented by Dr. Kirkwood to the American section and to a technical committee composed of United States and Soviet scientists and other delegates.

Among the major points presented in both reports were: (1) the catch reduction that resulted from the quotas did not improve the stock condition and the mean size of harvested crab continued to decline; (2) from 1964 to 1965, the total catch decreased by 26% (8.7 to 6.4 million crab); (3) the number of tans decreased only 14% (1,245 thousand to 1,069 thousand tans); (4) the number of cases decreased 27% (379 thousand to 275 thousand); and (5) the mean length of harvested crabs decreased from 156.9 in 1964 to 154.3 in 1965 to 150.0 in 1966.

Results of the negotiations were: (1) establishment of fishing zones for the Soviets and Japanese which would, in theory, reduce gear conflict and therefore curtail unnecessary mortality; (2) reduction of Japanese and Soviet annual quotas from 185 to 163 and from 118 to 100 thousand cases, respectively, for the 1967 and 1968 fishing seasons; (3) the type of data needed by the United States from the Japanese and Soviets for proper assessment of stock condition was given to scientists of each of these countries; and (4) the United States and Japan were requested to intensify research including, to the extent possible, an estimate of the maximum sustainable yield of the resource and to submit its findings to INPFC in time for INPFC to report to the governments involved the findings by November 30th of each year.

SHRIMP RESEARCH

ADF&G

Review of ADF&G (PL 88-309) pandalid shrimp research--Mr. Jerry McCrary

Research on species of commercial pandalid shrimp was initiated in

both Southeastern Alaska and Kodiak Island in 1963. The program was curtailed in 1964 due to lack of funds but resumed in 1965. Initial work was devoted primarily to commercial catch sampling which provided data on species composition and length frequency distributions from the major commercial fishing grounds. In Southeastern Alaska some initial life history work was accomplished and most of the trawling area utilized commercially was delineated. In the spring of 1966, a revised program was initiated in Southeastern Alaska. One objective of this program was to learn distribution, abundance, and growth rates of juvenile pandalid shrimp before they are recruited into the commercial fishery.

Two areas that have historically contributed the highest catches and that are now showing definite downward trends in catch rates are being studied. Present data indicates that both areas are important rearing grounds for juvenile pandalid shrimp. Post larval pink shrimp (Pandalus borealis) and sidestripe shrimp (Pandalopsis dispar) appear in both study areas in August and September. These shrimp range in carapace length from about 5.0 to 8.0 mm. At approximately 12 to 13 mm. they become vulnerable to commercial gear. Immigration is suspected in both areas because total catch and rapid fluctuations in catch rates cannot be accounted for in terms of effort.

BCF

Review of studies on juvenile and adult shrimp at the BCF laboratory at Auke Bay--Mr. Louis Barr

Shrimp studies at the Auke Bay Laboratory began in the summer of 1962 with a commercial catch sampling program at Wrangell. In early 1963, a project on the biology of pandalid shrimp was begun in the Kachemak Bay area. This project involved work on the life histories, ecology, and behavior of commercially important pandalids.

The basic life histories of the pink shrimp and sidestripe shrimp in Kachemak Bay have been determined. There are indications that deviations from the basic pattern may occur in some years and may result in a delay of a year or more in age at transformation from male to female.

An attempt to determine the fecundity of pink shrimp in Kachemak Bay (using egg masses collected half-way through the ovigerous period), disclosed an apparent high mortality during the 1966-67 ovigerous period. Approximately 50% (estimated) of the eggs had been lost from egg masses and approximately 30% of the remaining eggs were dead at the time of collection.

Trawl and pot catches at several sampling sites in Kachemak Bay were obtained twice each month (with some breaks in routine) over a three year period. Analysis of these data show a seasonal variation in abundance

and species composition of shrimp populations at the locations sampled. It appears that certain seasonal changes in population size and composition in these areas occur annually and are predictable.

Investigations of off-bottom occurrence of pandalid shrimp has shown vertical migrations of several species. These migrations occur during the dark period of each day and their duration is directly related to the length of the dark period. Apparently there is a difference in extent of vertical movement for different size groups within each species; that is, the smaller individuals show more tendency to migrate throughout the water column whereas the larger individuals tend to stratify at certain levels.

Marking of pandalid shrimp has been studied by BCF. An Atkins-type tag attached through the shrimp's abdomen proved unsatisfactory for although the shrimp survived tagging they were unable to survive molting with the tag in place. Clipping of a uropod tip is a satisfactory temporary mark, but the mark disappears through regeneration after several molts. Injection with either of two vital stains (trypan blue and fast green) provides a mark which colors the entire body of the shrimp for a short period (one to two weeks) but also provides a "permanent" mark through retention of the stain in the gills of the shrimp.

Review of early life history research on pandalid shrimp at the BCF laboratory at Auke Bay--Mr. Evan Haynes

The larval stages of two species of pandalid shrimp, Pandalus goniurus and Pandalus hypsinotus were reared in the laboratory by Ethelwyn Hoffman. The former species had six larval stages and the latter species five larval stages. These larvae were smaller than corresponding larval stages collected in the plankton, suggesting that rearing techniques need refinement.

Review of BCF exploratory fishing and gear research on the shrimp resource of Alaska--Mr. Lael Ronholt

The exploratory fishing and gear research base at Juneau has two research projects studying the shrimp resource of Alaska. The first, Marine Invertebrate Exploration, utilizes otter trawling techniques to locate commercial concentrations of pink shrimp (Pandalus borealis) and sidestripe shrimp (Pandalopsis dispar), while the second, Ocean Engineering, concerns shrimp trap research and explorations for the large spot shrimp (Pandalus platyceros).

Shrimp explorations in Alaskan waters were initiated by the Exploratory Fishing and Gear Research base at Seattle, Washington. During the early 1950's, this work took place in Southeastern Alaska, Yakutat Bay, and Prince William Sound; and in the western part of the Gulf of Alaska, in Cook Inlet, and offshore of the Pye Islands, Kodiak Island, and Alaska Peninsula.

The Alaska Exploratory Fishing Base was established in 1959. Their initial work was devoted to shrimp explorations for pink shrimp and sidestripe shrimp in the area extending from Montague Island to the Bering Sea.

During these explorations pink shrimp were the most abundant shrimp caught with the highest concentration caught in the Alaska Peninsula--Shumagin Island area. The sidestripe shrimp were found in lesser quantities, with highest concentrations of this species in the Kodiak Island area.

Experiments to determine the relative efficiency of various types of shrimp traps were started in Southeastern Alaska in the fall of 1965. Initially four different trap designs were tested. Results of the first cruise showed that rectangular and circular shaped traps were superior to square and triangular shaped pots.

During the next phase of work the best two traps from the first experiment plus three new models of rectangular traps and the commercially manufactured plastic igloo trap were tested. Other experiments included a new type of tunnel, a sloping ramp design, and covered versus open traps. The most efficient trap was the rectangular 18"x18"x36" metal frame, covered with 1-1/2" mesh nylon web and heavy weight burlap. Covered traps proved better than open traps and the ramp tunnel was successful enough to merit additional testing.

During the third phase the ramp tunnel was incorporated into the more successful metal frame traps. A new covering material, herculite, was also tested as well as the web and burlap covered traps and the igloo trap. These experiments showed that the metal frame rectangular trap was the most efficient.

The purpose of the present, or fourth phase, is to provide additional data about the herculite covered traps. Different sizes of tunnel openings and the efficiency of various baits are being tested also. A report on this experiment should be available early in June.

Panel Discussion, including plans for future research

Jerry McCrary reported on a new phase of the ADF&G shrimp project planned for the Kodiak area beginning in July, 1968. The initial effort will be to: (1) conduct a review of the Kodiak catch statistics (1960 thru 1966) to learn the relative importance of the various shrimp fishing areas in relation to catch per unit effort; (2) initiate a commercial catch sampling program to determine size and species composition; and (3) initiate a log book program.

Objectives of the shrimp study in Southeastern Alaska will be a continuation of year round sampling with a small mesh otter trawl to study the distribution, abundance, and growth rates of juvenile commercial pandalid shrimp before they are recruited into the commercial fishery. Also, to obtain data on the life histories, species composition, and structure of age classes of the commercial catch and to compare these data with those collected by small mesh otter trawls. Catch per unit effort data will continue to be collected.

Available data will be compiled and edited into an ADF&G informational leaflet.

Future shrimp research by the BCF will involve shrimp larvae as well as the juveniles and adults. Studies planned on the juveniles and adults were reported by Lou Barr and will consist of a continuation of the life history studies of the commercially important species. Habitat requirements also will be studied, particularly to find where and to what extent reserve populations of shrimp exist. Distribution of shrimp in mid-water will be studied using an Isaacs-Kidd mid-water trawl. Fecundity studies will continue in an effort to determine reproductive capabilities of the stocks.

Future research plans on the larval stages were reported by Evan Haynes and will consist initially of the description of the undescribed shrimp larval stages collected by BCF personnel. It may be necessary to raise some larval stages in the laboratory to obtain a complete series of larval stages for each species of commercially important pandalid shrimp. Artificial keys for the identification of each larval stage will then be compiled. Respiration experiments on the shrimp eggs and larvae are also planned for future work.

Lael Ronholt reported on the future work of the BCF Exploratory Fish and Gear Development Unit. The work will consist mostly of testing the effectiveness of various baits in shrimp pots. Testing of shrimp traps of various designs will continue but on a less extensive basis. More shrimp exploratory trawling is needed but this work may be curtailed until July, 1968.

KING CRAB RESEARCH

ADF&G

Review of the ADF&G king crab research--Mr. Guy Powell

The log book program is yielding valuable catch per effort data. Data of this type are obtained at almost no cost through the log book program. In addition, data on the distribution of many potentially important shellfish stocks are obtained when interviewing the fishermen and from studying their log books.

The continuing study of harvested males is providing data on size and shell age composition of fishable stocks, recruit abundance, and trends in the commercial harvest of crabs.

A joint study by research and management involves the detection of errors in the catch statistics reported by the fishermen and processors.

Better public relations with both fishermen and processors have helped to eliminate many of these errors.

King crab tag recovery efforts during the 13 month period April 1966-April 1967 have resulted in the recovery of 668 tags. Five hundred twenty-three of these were BCF tags. ADF&G tag recoveries were from two separate programs dating back to 1959, one of which was a continuous tagging program with king crab tagged in several locations. Tag recoveries from these latter locations ranged from 77% over a 32 month period at one location to 29% over a 35 month period at another.

The second season of field work of studying the king crab ocean breeding area off Kodiak Island was completed. In 1966 king crab were found molting and clasping on Portlock Bank. In 1967 the king crab of Marmot Flats were studied. The data show that Marmot Flats also is an important breeding area for king crab.

SCUBA diving investigations of juvenile aggregations and behavior are currently being studied and are aided greatly by reports of king crab aggregations by commercial fishermen. SCUBA diving is also used to study breeding king crabs. Definite differences were noticed between the 1966 and 1967 brood stocks with increased dependence on new shell adult male breeders for reproduction.

Catch statistics of king crab are now classified by depth and distance from shore. This classification has helped in monitoring catch trends of the fishery. Public relations is another important facet of the king crab research. Information of public interest is released through local newspaper, radio, and television as well as office visits by many groups and individuals interested in various aspects of the ADF&G activities.

Review of the ADF&G king crab log book program--Mr. Philip Gray

The log book program was begun in 1964 and was designed to obtain accurate information on catch per unit of effort and fishing trends in the Kodiak area. The number of crab fishermen keeping log books has increased from 28 in 1964 to 111 during the past fishing season. Whenever a vessel unloads crab at a local cannery, fishing information is obtained and skippers are encouraged to fill out log books if not already doing so. Experience has shown that more accurate data can be obtained through frequent collection of log books, although only periodic trips to outlying canneries are possible. The information recorded by the fishermen includes date, vessel license number, pot number, number of crabs in each pot, soak time, area caught, number of tagged crabs, type of pot used, and comments on females, soft crabs, halibut, other crabs and gear.

Data prior to June 1966 have been analyzed and show that the catch

per pot varies according to the area fished.

The log book data show nearly the same mean catch per pot lift for the 1964-65 and 1965-66 fishing seasons. It is believed that the data for the 1966-67 fishing season will show a considerable decrease in average catch per pot lift over that of previous years. The 1966-67 log book data have not been analyzed.

Review of ADF&G (PL 88-309 research on king crab breeding in offshore waters--Mr. John McMullen

The primary aim of this project is to delineate the king crab ocean breeding areas near Kodiak Island and to evaluate the relative importance of the different ocean banks as breeding areas.

A field program was initiated in April, 1966. Two types of gear (crab pots and otter trawls) were fished to determine which method was best suited to capture molting and breeding king crab.

King crab were found molting and clasping on Portlock Bank. Trawls collected large numbers of female king crab which were approaching or had recently completed ecdysis. On the basis of these findings trawls were selected as collection gear for the 1967 data collection program.

Marmot Flats, East of Cape Chiniak, Kodiak Island was selected as the 1967 study area. Two hundred forty square miles of the Flats were divided into four square mile study areas. A stratified sampling program was devised and the field program was completed during April and May of 1967.

An initial summary of the data shows that king crab are molting and breeding on Marmot Flats. Seventeen grasping pairs of king crab were captured at 9 widely dispersed study stations. Large numbers of females approaching and recently completing ecdysis were captured also. The findings indicate that Marmot Flats is a king crab breeding area.

Review of ADF&G research on length-shell age of king crab--Mr. Peter Jackson

The first length and shell age composition measurements of commercially caught king crab were taken between 1954 and 1957. These data were not considered suitable for the study of growth and the sampling was discontinued until the present program was initiated in 1960.

The purpose of the present study is to establish an acceptable sampling program as well as to define trends in recruitment and shell age ratio by season for stocks. Since 1960, 38,000 crab have been measured. In the last two fishing seasons about 1/10 of one percent of the 11.5 million crabs caught were sampled.

Preliminary analysis shows marked differences in recruitment occurring both between and within stocks. These data show no indication of segregation of crabs by shell age or carapace length while confined to vessel holds. Very few samples show greater than 20% skipmolt crabs.

Data collected to date are listed on IBM cards and are available for analysis.

Two films on the mating, molting, and juvenile podding behavior of king crabs in the Kodiak area were shown by Guy Powell.

BCF

Review of BCF research on king crab in the Gulf of Alaska--Dr. David Hoopes

Responsibility for Federal research on king crab in Alaska was transferred from Region 1 to Region 5 in 1961. Since that time, BCF efforts have been directed toward achieving three major long-range objectives. These are: (1) delimit the location, movements, and abundance of king crab stocks present in the fisheries, (2) collection of vital statistics and determination of the bio-dynamics of each identified stock, and (3) determination of the physical, chemical, and ecological characteristics of the king crab environment. To date, major emphasis has been placed upon the first of these three objectives. Tagging studies are used to help define stock limits and ascertain general movements and migration routes.

The first research was conducted in the Kodiak Island area. Seasonal field work began in 1961 and was terminated in 1964. During that time, 16,696 tagged king crab were released offshore outside the limits of the fishery. By the end of 1966, fishermen had returned 6,361 tags for a recovery of 38%. These data were used in several computer programs designed to plot the distribution of tag returns from various release locations. IBM listings are completed and are being analyzed to determine the extent of separate stocks. No further tagging is planned for the Kodiak area and tag recovery efforts will be greatly reduced after the next fiscal year.

Work in the Shumagin Islands-Unalaska Island area began in 1965 with objectives similar to those of the Kodiak Island study. In two years of work, 10,955 tags have been released and 3,667 (33%) tagged crab have been recaptured. Tags are collected by the processors and periodically picked up by BCF personnel. The recovery data have not been analyzed in detail. A cursory examination of the returns indicates, however, the presence of only a single stock in the Shumagin Island-Unimak Bight area.

Review of BCF tag collection program in the Kodiak Island and Seldovia-Homer area--Messrs. Robert Meyer and Roland McBride

Mr. Robert Meyer reported that tag collections depend heavily on the

cooperation of the fishermen, processors, and members of the research divisions of the ADF&G. Of the tags recovered, about 50% are collected by BCF personnel, whereas the remainder are collected by ADF&G personnel. About once a month, tags are collected from the processors in outlying areas. These processors keep the tagged crab frozen until the crab are measured by BCF personnel. At that time, the usual tag recovery payment is made to the processor who in turn pays the fisherman for collecting the crab.

Mr. Roland McBride described the BCF tag collection program in the Seldovia-Homer area. This program is similar to other BCF tag recovery programs.

Review of BCF king crab research in the Bering Sea--Dr. J. Frank Hebard

The ultimate goal of king crab research in the Bering Sea is the determination of a maximum sustained yield which the southeastern Bering Sea king crab stock will support. Distribution, reproduction, growth, mortality, recruitment, and environmental factors affect abundance and therefore must be understood before this goal can be realized.

The field program carried out in 1966 was the first survey made in southeastern Bering Sea since 1961 and was designed to duplicate the BCF surveys carried out during the summers of 1957-1961. Duplication of station pattern and sampling technique allows direct comparison between years of the distribution and abundance of the southeastern Bering Sea king crab stocks.

The vessel M/V SONNY BOY was chartered for a 90 day period, mid-May to mid-August. The field survey carried out from the SONNY BOY can be separated into two parts: a station pattern survey and a mass tagging operation. During the station pattern survey, a grid of 80 pre-selected stations was sampled by towing a modified 400-mesh eastern otter trawl for one hour at each station. All king crab collected were measured for length and width and all male king crab were tagged. In addition to king crab, other animals that were collected were identified and counted. Other data collected included temperature, salinity, bottom sediment type, in-fauna, and plankton.

Following the trawling survey, a tagging study was completed in areas where male crab were abundant. The total number of tags released during the survey and tagging study was 5,096. An additional 344 tagged crab were released by a biologist while aboard the charter vessel, ARTHUR H (International North Pacific Halibut Commission charter). These crab were released primarily in areas along the periphery of the station pattern occupied by the vessel SONNY BOY. The total number of tags released in 1966, therefore, was 5,440.

In addition to research cruises, the field program also involved sampling of the commercial king crab harvest from the Bering Sea for length, width, weight, and shell condition. To date, only the Japanese and the U.S. commercial harvests have been sampled. We have not sampled the Soviet harvest.

A U.S. biologist collected size data on Japanese caught king crab in 1965 and 1966. The mean length of the crab caught by the Japanese was less in 1966 than in 1965, despite definite sample biasness by the Japanese. These data were used by the United States in a successful effort to reduce the Japanese harvest quota.

Travel restrictions have hindered biologists in their sampling of the United States harvest; thus, only two samples from the United States commercial effort in the Bering Sea have been collected, one in late March and the other in early May, 1967.

Review of BCF early life history research on the king crab--Mr. Evan Haynes

The larval stages of the crab Paralithodes platypus were reared in the laboratory by Ethelwyn Hoffman. She learned that the crab has four zoeal stages and a single glaucothoe stage. Descriptions and drawings of each larval stage (including glaucothoe) were completed and a manuscript titled "Description of Laboratory-reared larvae of Paralithodes platypus (Brandt) (Decapoda, Anomura, Lithodidae) is in press.

Sampling at Kachemak Bay showed that larvae of P. camtschatica first appeared in the plankton in early April and the last of the larvae had settled from the plankton by early July. Molting frequency of the larvae was about every two weeks.

To determine the increase in size per molt, post larval king crabs up to 25 mm carapace length were collected in the vicinity of Auke Bay and held in the laboratory. Crabs 6 to 10 mm in carapace length molted every 6 to 8 weeks whereas those 10 to 20 mm in carapace length molted every 2 to 2-1/2 months. The percentage increase in carapace length of growth per molt ranged from 13 to 33%.

Use of computer programs in biological research, particularly research on the king crab of the Kodiak Island area--Mr. Joseph Greenough

After the initial keypunching of basic tag release and recovery data, summaries of growth and plots of tag recoveries by depth, month, and year for given groups of releases have been obtained.

Also discussed was the use of Standard Programs whenever possible because of time limitations in writing new programs. More data are needed

on mortality and pre-recruitment before results of the population models can be considered valid.

Panel Discussion, including Plans for Future Research

The conditions of the Kodiak Island stocks of king crab were discussed by Guy Powell.

The catch per unit of effort in Kodiak has declined for the first time this year, and is probably the result of the increase in the number of king crab vessels (143 in 1960 to 213 in 1966) as well as an increase in average vessel size.

Commercial catch length frequency data for 1954-65 show a reduction in modal size of crabs with the fishery becoming more dependent on recruits than previously. Whether or not the fishery is dependent on a single age class is not known. It will be easier, however, to estimate mortality with fewer age classes in the fishery. Nor is it known what effect the reduction in numbers of males has had upon the females.

Dr. Hoopes believed that information on the king crab in the Shumagin Islands-Aleutian Islands area was too meager to warrant valid conclusions about stock conditions.

Dr. J. Frank Hebard commented on the stock condition of the Bering Sea king crab.

The factors used for determining the stock condition of Bering Sea king crab are crab abundance, catch statistics from the foreign and U.S. commercial catch, and size frequency. The king crab abundance was determined from U.S. trawling surveys in the summer of 1966. Station pattern duplicated that of earlier surveys. The abundance of females was similar to that of previous years (1957 thru 1960) which suggests no major changes in reproductive potential. Abundance of small crab (those less than 125 mm carapace length) in 1966 was less than that found in 1957 and 1958 but similar to the 1959 and 1960 estimates. Commercial crab (those greater than 125 mm in length) were only 1/2 to 1/5 as abundant in 1966 as during the period 1957-1960.

Catch per tan and catch per tan-day are used to study catch per unit of effort of the Japanese and Russian fleets. Since 1959, catch per tan by the Japanese has continued to decrease from about 17.0 to only 9.4 in 1966. Catch per tan-day has dropped from 1.2 in 1957 to 0.3 in 1966. The net soaking time has continued to increase each year. In 1965, the mean soaking

time for each net was 23.5 days; this increased to 29.5 days in 1966.

Analysis of size frequency of southeastern Bering Sea king crab caught by the BCF research vessel SONNY BOY during 1966 showed a large group of king crab less than 80 mm long. This is the first time since 1957 that so many small crab were found.

The Japanese commercial catch was sampled by a BCF observer aboard the factory ship TAINICHI MARU in 1965 and 1966. After correcting for sample size, the mean size of crab caught in 1965 was 152 mm and in 1966 150 mm in length. There was also an increased utilization of crab between 110 and 135 mm in length. Since the legal size defined by international agreement is 145 mm in carapace width (about 125 mm in length), an increased effort in the harvest of sub-legal crab is indicated. The Japanese, themselves, in the 1966 INPFC report admitted that the mean length of harvested crabs has been decreasing since 1960. They suggested, however, that the catch per tan of commercial size male crab had increased. In addition, their research vessel statistics showed that the juvenile crab stock had increased in 1966 compared to 1965. These data are misleading since the 1966 Japanese sampling stations were clustered in areas of high abundance of small crab. In 1965 the stations were not clustered.

In summary, it is obvious that the stock condition of king crab in the eastern Bering Sea has not improved since 1965 and, in fact, appears to have deteriorated.

Discussion

Dr. James Kirkwood mentioned that a point to consider regarding juvenile abundance and the number of females reproducing is the fact that the limiting factor for juvenile abundance perhaps is not based on reproduction of females but possibly an item in the food chain.

Dr. Murray Hayes stressed that another important unknown in relation to stock condition is the rate the stocks are fished and that not knowing this rate, it is difficult to determine the health of a stock since the sustainable yield may be 1/3 of the catch yet stocks could still be healthy.

Mr. Bob Simon mentioned that mean weight per crab fluctuations, as shown by fluctuations in the Aleutian king crab stocks, could be attributed to fishing ability, fleet exploration, or crab distribution rather than actual stock condition.

Long range research plans of the BCF for studying the king crab--
Dr. James Kirkwood

The first objective will be to complete an analysis of the tag return data that BCF has collected in the Kodiak area since May 1961. This analysis should determine if separate stocks exist and, if so, the geographical range of these stocks. It should also determine migration routes, growths, etc. of king crab which, when combined with catch statistics, will enable the BCF scientists to estimate maximum sustainable yields of the stocks.

Tagging data recovered up until July of 1968 will be incorporated into the analysis. Tag returns may be collected after July 1968 but on a much reduced scale.

The objectives of the Shumagin Islands westward studies will be similar to that of the study in the Kodiak Island area.

United States research on king crab in the eastern Bering Sea is designed to fulfill our obligations to INPFC and the agreements with the Soviets and the Japanese. The observer program will probably be continued as well as research trawling, tagging, and other studies.

Because of the need to understand the environment in more detail to accurately predict stock yields, greater emphasis will be placed on environmental studies. About 1/2 of the BCF shellfish staff at Auke Bay will be assigned to these studies. These studies will include a large-scale investigation of an estuarine environment located in Southeastern Alaska. This study will be one of the most complete studies of its kind and will include personnel of the Oceanography and Marine Fisheries programs at the Auke Bay Laboratory, Douglas Marine Laboratory, Federal Water Pollution Control Board, and other organizations.

Long range research plans of the ADF&G for studying king crab--Mr. Guy Powell

These plans are as follows: (1) the analyzing and publishing of accumulated data; (2) the construction of population models for Kodiak stocks of king crab; (3) the refinement of the log book program; (4) the studying of the reproductive requirements of the king crab stocks; (5) the development of trends in catch per effort, size, and shell age composition of the legal male stocks; and (6) the studying of the possibility of making valid annual predictions.

Discussion

Mr. Bob Simon mentioned that future research objectives must involve keeping industry informed to insure logical fleet and processing expansion. Also mentioned was the fact that pre-recruit studies may be the answer to making predictions.

Mr. Wallace Noerenberg stated that future expansion in shellfish research is probable through release of additional monies that will become available when present salmon projects funded by PL 88-309 are terminated.

Mr. Tak Miyahara presented several comments and suggested that the following points should be considered in present and future research projects: (1) the need for analysis of present data; (2) clearly defined objectives of sampling and tagging programs; (3) studies of prediction (numbers present versus numbers harvestable) should have a high priority; (4) limit programs to realistic levels; and (5) the need for more cooperation between ADF&G and BCF research personnel.

Mr. Joe Greenough stressed that data analysis is underemphasized presently, and that too much data is being stockpiled. As a result, there is danger that data may be misinterpreted by people unfamiliar with the subject.

Mr. Wallace Noerenberg stated that both the ADF&G and BCF agencies have new computer programs planned to aid in data analysis.

LATENT AND MINOR FISHERIES ON OTHER SPECIES OF MOLLUSCS AND CRUSTACEANS

Need for research on the soft shell clams (Mya sp.) of Alaska-- Dr. James Kirkwood for Mr. James Gross

Mr. James Gross died on the 19th of May, shortly before the shellfish conference convened. Dr. James B. Kirkwood, Chief of Shellfish Investigations for the BCF, using notes that Mr. Gross was assembling for a presentation at this conference, prepared and read the following report in honor of Mr. Gross.

It is the opinion of the Institute of Marine Science that a clam industry should be developed in Alaska and that research advancing the development of such an industry on a continuing basis should be established.

Some of the research questions that need answering are as follows: (1) What is the total size in weight and potential production of the clam resource in Southeastern Alaska and what are its geographic distributions and concentrations in various habitat areas? (2) At what stage of growth and development are clams best suited for harvest to give maximum sustained yield of meat per unit of area? (3) Will harvesting at the age which gives optimum yield in meat per unit area permit a sustained population of the desired density?

To answer some of these questions the reproductive cycle must be studied. This study would include the age at which the species becomes sexually mature, the age at which sexual products are quantitatively sufficient to replace or enlarge the population, and the rate of larval development

in the geographic area of concern and the subsequent period of transport. To accomplish this, laboratory studies of larval development need to be made under controlled conditions so that veliger larva identification could be positive in field specimens.

Larval transport periods, flushing rate of embayments, and the direction and velocities of shorewise currents as well as mortality rates are of great importance in understanding population dynamics of molluscs.

Clams of the genus Mya have been recorded throughout Alaska. The soft shell clam, Mya arenaria, has been collected on the Eagle River flats north of Juneau and the clam, Mya truncata, at Cold Bay, Kachemak Bay, and various areas of Southeastern Alaska.

It is desirable to collect Mya all along the Alaskan coast to obtain all intergradations of either of the two (or more) species that are living there today. Knowledge of these intergradations is necessary for a complete understanding of the amount of speciation and distribution of each species in the Pacific area. This knowledge is also necessary for the recognition of fossil findings. The interpretation of these findings will aid in the understanding of past species migrations and past climatic and geologic changes.

There are other than purely scientific reasons for studying the genus Mya in Alaska. All species and their forms are edible by man. They have a distinctive delicious flavor unlike that of any other clam. Mya arenaria is highly prized as food and on the east coast is the basis of a sizable industry. Stocks can be transported and transplanted and, as demonstrated on the New England coast, the stocks can be readily replenished after they have been overfished.

They are of further economic importance in that they are eaten by crabs and fish and are seemingly a major food of the walrus.

Although they represent a resource, the importance and size of this resource is inadequately known.

Attempts at introduction of the European oyster in Alaskan waters--
Mr. Stephen C. Smedley

The common European oyster Ostrea edulis has its natural habitat along the Atlantic coast of Europe from Norway to Spain. Through the cooperation of the United States BCF Marine Laboratory at Milford, Connecticut, 550 of these oysters (each about the size of a thumbnail) were shipped to Alaska in April of 1966. The purpose of this importation was to test the reported ability of O. edulis to spawn in colder water than Pacific oysters, with the idea of establishing the imported animal in Alaska.

We have now had O. edulis in Alaska for one year. We can report little at this time. We know the animal can survive in Southeastern Alaska's

northern (colder) area. Growth has been disappointing, but it must be remembered that these oysters were subject to much handling and several environmental changes during this period. We are now looking to southern Southeastern Alaska for a warm bay in which this species can be seeded.

Review of the shellfish toxicity problem in Alaskan waters--Dr. Murray Hayes

The term "Shellfish Toxicity" is a misnomer that infers toxicity in association with all crustacean and molluscs, but generally applies only to clams and mussels. It is properly called "Gonyaulax" poisoning, which is the generic name of a group of dinoflagellates commonly associated with "red tide". This condition is not necessarily indicative of clam toxicity as clams may be toxic when no plankton blooms are present. All bivalve molluscs are susceptible to Gonyaulax poisoning but some are affected more easily, due to different rates of accumulation and excretion. The butter clam (Saxidomus giganteus) presents particular problems as this species accumulates the toxin over a period of time and eliminates it very slowly; these clams may therefore remain toxic year around. It differs from other species in that 75% of the accumulated toxin is stored in its siphon. A general rule is to eat clams only during months ending in "R" as clams, if toxic, are generally least toxic during this period.

Past research on clam toxins has been conducted primarily in Southeastern Alaska, but at present no research is in progress. As yet, we cannot predict when clams will become toxic. We do know, however, that "inside" waters are usually more toxic than "outside" waters.

Extraction of the toxin and studies of its chemical nature are complicated and expensive. Perhaps the most promising possibility for making clams safe to eat lies in the detoxification of clams through holding.

Results of BCF scallop explorations in Alaskan waters--Mr. Lael Ronholt

To date very little exploratory effort has been expended on the scallop resources of Alaska. In May and June 1963, 82 exploratory scallop tows were made in the waters between Cape St. Elias and Lituya Bay using an 8' New Bedford type scallop dredge. Several good concentrations of scallops were found off Cape Fairweather, Icy Bay and east of Cape St. Elias. Catch rates ranged up to a maximum of 7 bushels of scallops per 30 minute drag. The scallops east of Yakutat ranged from 2-3/4 to 6-1/2 inches in length of which 75% were between 3 and 4 inches. West of Yakutat the size ranged from 3 to 7 inches with 82% of the scallops falling between 5 and 6-1/2 inches. Meat yields ranged from 2 to 5 pints per bushel of whole scallops.

The depths at which scallops were caught ranged from 39 to 76 fathoms. The mean catch in bushels per 30-minute drag for each depth interval was:

Depth in fathoms	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79
No. of bushels	0.6	1.2	1.5	0.8	0.1

During the shrimp exploration of 1963 and 1964, the 8' New Bedford type scallop dredge was fished at 67 stations in the vicinity of Kodiak Island. The highest catch was 250 (6-inch) scallops taken in Marmot Bay. Only 6 tows produced over one bushel of scallops.

Review of ADF&G (PL 88-309) research on the Dungeness crab--Mr. Carl Lehman

A population dynamics study of the Dungeness crab was initiated in Southeastern Alaska in 1963 with tagging operations conducted aboard commercial crab boats in an area of high commercial production near Petersburg. Fifteen hundred crabs were also tagged and released during explorations in other areas. Tagging studies and observations on shell condition, size, sex, and depth of capture are still in progress.

A study is being conducted on the effects of log rafting on crab grounds with the before and after effects recorded through SCUBA diving surveys.

Since 1963, 4,000 tagged crabs have been released. These tags are retained by the crab during molting. Five hundred seventy-five tagged crabs have been recaptured and 110 growth observations have been recorded on male crabs that at the time of tagging ranged in length from 128 mm to 149 mm. No migration patterns have been detected.

Observations in one study area indicate that the summer fishery is dependent upon crabs within the size range of 135-171 mm. Growth within this range amounts to 25-30 mm per molt with a few skip molts; no molting was noted after the crabs reach 171 mm. Breeding occurs from September to November and ovigerous females appear about two months later. The eggs are carried on the female throughout the winter and hatch during March and April.

RECOMMENDATIONS TO MANAGEMENT ON SHELLFISH PROBLEMS

Recommendations to management on shellfish problems were discussed by Messrs. Murray Hayes, Guy Powell, Tak Miyahara, and James Kirkwood.

Dr. Hayes emphasized: (1) that researchers should be willing to advise management even if the researcher does not possess extensive data that support his conclusions; (2) managers should recognize the value of such advice and use this advice wisely; (3) more length-frequency and effort data should be collected from the fishery; (4) researchers should conduct research that has a well defined goal and not become overly involved in studies of lesser importance; (5) log book data are very valuable and should be collected

whenever possible; (6) random sampling is not necessarily "sacred" and researchers should also consider non-random sampling; (7) more effort is needed by researchers on studies of pre-recruit abundance; (8) data should be freely exchanged between investigators both within and between agencies; (9) the female king crabs should also be studied even though they are not harvested in such vast numbers as the males; (10) available data should be analyzed in detail; (11) simulation research, such as the use of population models, should be studied in greater detail; and (12) if possible, unexploited king crab stocks should be studied in great detail as a basis for king crab studies in other areas.

Mr. Guy Powell requested: (1) better communication between managers and researchers; (2) that management should seek advice from the researchers more often; (3) the establishment of statistical areas for shellfish that would differ from the statistical areas for salmon that are now used; (4) development of a statewide log book program; and (5) that management personnel should publish results of their work more often.

Mr. Tak Miyahara suggested that management should request information more often and also communicate more frequently with researchers. Researchers should feel obligated to give management the data it requires.

Dr. James Kirkwood stated that certain data should be withheld by a researcher since the researcher is responsible for the interpretation of the data; yet, the data should be given to management without unnecessary delay. The opinions of the researchers do not have to be in written form if the researcher is worried that his written opinions may establish unwarranted conclusions. He recommended continued study of the occurrence of non-ovigerous mature females and suggested that a study designed to determine the apparent lack of a full clutch of eggs on female king crab in the Kodiak area may be warranted.

Discussion

Mr. Roy Rickey commented that since management needs determine the objectives of research, biologists should not forget that research should be designed to solve management problems only and not biological questions of a non-management nature.

Mr. Carl Lehman questioned whether management was qualified to dictate the objectives of biological research.

Mr. Joe Greenough suggested that a limited entry into the fisheries may be necessary.

Mr. Tak Miyahara stated that limited entry would require a change in the State Constitution. Yet a quota system may not be as desirable as gear limitations.

It was agreed that the Second Alaskan Shellfish Conference be tentatively scheduled for early June 1968 in Anchorage, Alaska. Messrs. Carl Lehman and Frank Hebard will be the coordinators during the preparation for the second conference.

LIST OF PARTICIPANTS

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Other

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